

REMARKS

The Official Action and the cited references have been carefully reviewed. The review indicates that the claims, especially as amended, recite patentable subject matter and should be allowed. Reconsideration and allowance are therefore respectfully requested.

Before contending with the grounds upon which the rejections have been made, a brief summarization of the essentials of the claimed matter will be related to establish a clear line of distinction between applicants' matter and the disclosures in the cited and applied references.

Although the prior art disclose copper indium diselenide/zinc oxide heterojunction formations utilizing zinc oxide spray pyrolysis or ion beam sputtering, neither method results in an conversion efficiency of greater than about 2-3% - therefore, these prior art methods do not disclose a commercially viable method for the replacement of CdS with zinc oxide in a thin film copper indium diselenide heterojunction cell characterized by high conversion efficiency without incurring the disadvantages of utilizing a CdS layer via wet chemistry, utilizing slow, batch processes, employing the highly toxic material of Cd, which escalates manufacturing costs as a result of handling and disposal of this hazardous waste.

The claimed matter of applicants' constitutes an improved process for making CuInGaSe_2 thin film solar cells with conversion efficiencies $>2-3\%$, and yet avoids a need to deposit a buffer layer. This becomes readily apparent upon reviewing the graph FIG. 1 which shows current density versus voltage for CIGS thin film not subjected to an evaporant species of zinc acetate dihydrate and on which ZnO was sputter deposited to arrive at a conversion efficiency of only 1.8%.

By contrast, FIGS. 2, 3, 4, 6A-6G, 7A-7G, 8A-8F and FIG. 9 are graphs showing current density versus voltage for CIGS thin film subjected to an evaporant species of zinc acetate dihydrate followed by sputter depositing ZnO to provide conversion efficiencies ranging from 3.45 to about 13.1%.

Claims 18 and 19 were rejected as being anticipated by or in the alternative, obvious over Ramanathan et al. under 35 USC §102(b) and 35 USC §103(a).

Applicants respectfully traverse this rejection and request reconsideration for reasons hereinafter expounded.

A careful review of WO 99/17377 to Ramanathan et al. reveals that its process clearly lacks subjecting CuInGaSe₂ films to an evaporant species of zinc acetate dihydrate to dope the surface region n-type. Accordingly, this reference fails to anticipate applicants' claimed matter as presently recited.

Withdrawal of the rejection is respectfully requested.

Neither does Ramanathan et al. render the claims obvious for the reason that its process entails:

- (a) depositing a first film of p-type copper indium diselenide film on a metal back contact;
- (b) depositing on the upper surface of the copper indium diselenide film a group II (a,b) and VII elemental salt;
- (c) converting the p-type of the upper copper indium diselenide film surface to n-type by thermal diffusion of the salt into the copper indium diselenide film;
- (d) depositing a second thin film layer of high resistivity zinc oxide; and

(e) depositing a third film of n-type transparent zinc oxide on the second thin film high resistivity zinc oxide layer.

While the Ramanathan et al. photovoltaic cell is cadmium free and eliminates the use of an interfacial extrinsic buffer layer, this reference lacks use of an evaporant species of zinc compound to dope $\text{CuInGa}(\text{Se}_2)$ with Zn and etching with acetic acid in an amount of about 50% by volume in water to remove ZnO, followed by sputter depositing ZnO on the Zn compound evaporant species treated layer of $\text{Cu}(\text{InGa})\text{Se}_2$. As has already been alluded to above with reference to FIG. 1, when the CIGS film is not subjected to an evaporant species of zinc on which ZnO is sputter deposited, the current density versus voltage and the conversion efficiency are inferior to CIGS thin films so treated, as shown in the graphs of FIGS. 2, 3, 4, 6A-6G, 7A-7G, 8A-8F and FIG. 9. Accordingly, there is no mention of or reference to use of subjecting $\text{CuInGa}(\text{Se}_2)$ to an evaporant species from a Zn compound to dope the CIGS with Zn and etching an acetic acid followed by sputter depositing ZnO-and having access to applicants' innovation via hindsight is not a permissible basis for concluding that it would be obvious from the disclosure of Ramanathan et al. to incorporate steps c) and d) as required in applicants' claims.

Withdrawal of the rejection is respectfully requested.

Claims 1-9, 18 and 19 were rejected as being unpatentable over Ramanathan et al. under 35 USC 103(a).

Ramanathan et al. has been discussed above; however, it is worthwhile repeating that Ramanathan et al. lacks applicants' steps c) and d).

Accordingly, these claims as presently recited would not be obvious in view of Ramanathan et al.

Withdrawal of the rejection is respectfully requested.

Claims 10-17 were rejected as being unpatentable over Ramanathan et al. as applied to claims 1-9, 18 and 19, further in view of Wright et al. under 35 USC §103(a).

Applicants respectfully traverse this rejection and request reconsiderations for reasons hereinafter set forth.

Ramanathan et al. has been discussed above; however, the deficiencies enumerated in connection with Ramanathan et al. are not compensated for in the teachings of the secondary reference of Wright et al.

This is so because, a review of Wright et al. shows that it relates to a non-related art of forming relief images employing photosensitive microcapsules. And even though it utilizes etchants for supports such as zinc that may be acetic acid, one skilled in the art of making thin film solar cells would not look to the art of making relief images for solutions to eliminate the use of cadmium sulfide and its associated toxicity as a hazardous waste material and maintain a CIGS thin film characterized by high conversion efficiency.

But in any case, even if the acetic acid from the non-related subject matter disclosure of Wright et al. were substituted for the hydrochloric acid etchant agent in the process of Ramanathan, applicants' invention would still not result for the reason that Ramanathan et al. lacks use of an evaporant species from a zinc compound to dope a CIGS cell, as presently recited in applicants' claims.

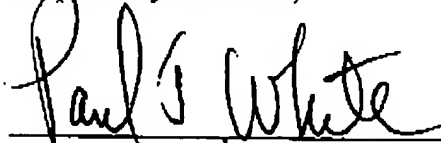
Withdrawal of the rejection is respectfully requested.

Claims 1-17 were rejected as being indefinite for failing to particularly point out and distinctly claim the subject matter under the second paragraph of 35 USC §112; however, in view of the amendments made to these claims per the examiner's recommendations, this rejection is no longer applicable.

Note is taken of the objections raised to the specification; however, the informalities referred to in the rejection have been remedied per the examiner's suggestion.

In view of the foregoing amendments, remarks, and arguments, it is believed that the application is now in condition for allowance and early notification of the same is earnestly solicited.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Paul J. White", is written over a horizontal line.

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